

DEFENSE BUSINESS BOARD



Optimizing DoD's Science and Technology Investments

January 22, 2015

*These are the final briefing slides as approved by the Defense Business Board in its public meeting held on January 22, 2015.
The full DBB report will contain more detailed text which will reflect the totality of the points discussed and
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Overview

- **DoD Science and Technology budgets large but declining**
 - \$12B Base Budget
 - \$30B when including weapons development with DoD labs
 - 6.1- 6.3 Budgets down 18% since 2010

- **Our tasking: Key Questions**
 - How can DoD focus its S&T investments in a period of declining budgets to support future warfare capabilities?
 - What can DoD learn from the way private sector manages its S&T spending?
 - How can DoD leverage its S&T investments by exploiting the much larger private sector investments?
 - How can DoD focus its S&T resources in areas where the private sector is poorly suited to contribute?

This DBB Task Group report should be considered in conjunction with the 2014 DBB Task Group report on Innovation

Methodology

- Reviewed current/past DoD strategic and financial documents and reports/studies from think tanks and government agencies
- Evaluated efforts in private/public sectors and DoD experience to identify practices that resulted in both success and failure
- Conducted interviews with individuals from the private sector and government, including:
 - Current and former CEOs and Chief Technology Officers (CTOs) of Fortune 500 companies with experience in leading successful technology developments
 - Senior defense industry executives with responsibility for their companies' R&D activities
 - Private sector individuals with knowledge of the small and emerging companies focused on cutting edge technology
 - Current and former DoD leaders with responsibility for the full range of S&T and R&D activities
- Task Group
 - Mr. Phil Odeen (Chair), Mr. Howard Cox, Ms. Roxanne Decyk, Mr. Jack Zoeller, Mr. John O'Connor (Consultant), and CDR Bruce "Crash" Defibaugh, USN (DBB Military Representative)

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Findings - Overview

- I. Commercial S&T Best Practices differ markedly from those of DoD
 - Companies tightly link S&T to corporate business strategy
 - Top level leadership (CEO/COO) is deeply involved in managing S&T
 - Companies have structured S&T management processes with metrics, milestones, and regular reviews
 - Reviews result in tough choices: continue, kill, or double down
 - Compensation system reinforces the S&T process, rewarding success and “intelligent failure” – Don’t penalize taking sound risks
 - Companies make extensive use of partnerships with universities, small companies, and venture funds to augment the in-house development staff
 - Start-up companies cluster around major research universities which attract many other cutting edge companies
 - Crowdsourcing is a growing practice that has proven successes in government as well as non-profits and the private sector

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Case Study – Large Pharmaceutical Company

R&D is central to corporate success; New products are their life blood

S&T strategy is the focus of corporate leadership

- What are the unmet medical needs 10 years in the future?
- What transformational products are possible given the evolution of science?
- Will the market pay for it?
- Outcome – a few disease areas and a number of high pay-off drug targets with budgets and timelines

Technology development process is tightly managed

- Data driven milestones and metrics
- Rigorous reviews at each milestone – continue, double-down, or kill
- Hold researchers accountable for success but reward intelligent failure
- Collaborate with academia and small genetic medical companies

R&D Pipeline is Closely Managed

- Management done by senior leadership team – use outsiders and devil’s advocates
- Product teams must be willing to take risks yet have a culture of “truth seeking”
- Create environment for teams to work productively, attract talent
- Compensation system rewards progress with bonuses

Note: two other private sector case studies are in the appendix



Findings- Overview

II. DoD faces a number of S&T challenges

- DoD strategy is policy driven; not specific enough to be used as a basis for S&T priorities
- There is no DoD wide or Service S&T strategy or clear, enforceable priorities
- Large, complex lab structure is loosely coordinated
- Aging, stove-piped workforce is inwardly focused
- Inflexible compensation systems make it difficult to reward (or incent) focus and success
- Industry's Independent R&D spending (\$4.5B) is loosely tied to DoD technology needs

III. DoD processes are poorly structured to attract cutting edge commercial technology

- Poor visibility of cutting edge technologies; limited interactions with the high tech sector
- Many innovative companies have little interest in working with DoD
- There are many impediments for companies trying to work with DoD
- Impediments are compounded by limited experience dealing with true commercial companies and a mindset based on interaction with the defense industrial base

IV. Recent DoD initiatives show promise to remedy some of these problems

- The Long Range Research and Development Plan initiative
- "Reliance 21" to coordinate 6-1 to 6-3 spending across DoD
- Defense Innovation Marketplace to facilitate outreach

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discussion of the findings***

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Findings

I. Commercial S&T best practices differ markedly from DoD's

- A. Commercial S&T priorities and investments are strategy driven
 - Corporate strategy drives S&T strategy and priorities
 - Senior leadership (CEO/COO/CTO) is deeply involved in all major decisions
 - S&T strategy reviewed regularly with revisions driven by changes in corporate strategy and progress on S&T projects
- B. Companies have structured management processes for R&D efforts
 - The S&T governance structure has clear responsibilities and authorities at each level
 - Companies focus on a small number of mission-critical developments that get funds, best people, and support
 - Corporate level board rigorously assesses progress at key milestones using well designed metrics
 - Make tough choices, e.g., kill, double down, or defer for the future
 - Establish a process to cross-fertilize developments between business units; share learning and best practices – often a challenge
 - Reward excellent performance through a well designed compensation system
- C. Companies seek to control Intellectual Property (IP) which they see as critical to executing their S&T strategy and business plans
 - Companies maintain control over their IP but partner with companies and universities that have the expertise when their internal R&D staff lacks it
 - Some companies create internal venture capital (VC) capability or work with VC funds to access small, start-up companies
 - Small companies are often acquired for needed technology and expertise

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Findings

I. Commercial S&T best practices cont'd

- D. Small, often start-up, companies cluster around areas near major research universities (e.g., Stanford, MIT, and UCSD)
 - Exploit people/ideas from Universities and other small companies
 - Focus exclusively on a few technologies that will succeed in commercial markets (little interest in working for DoD)
 - Have access to venture funding and “Angel” investors

- E. Some Non-Profits (e.g., Gates Foundation) “crowdsource” for technology solutions; a practice now being emulated by the Commercial sector
 - Attracts widely different ideas and proposals from many sources
 - Commercial sites, such as Innovation Posting, are expanding rapidly to enable “crowdsourcing” by private sector companies
 - UK Ministry of Defense employs a unique approach, the Centre for Defence Enterprise, which provides seed capital for promising ideas

Findings

II. DoD faces a number of S&T challenges

- A. There is no clear S&T strategy process or set of priorities at OSD or Military Department levels
 - “Our approach to R&D planning at the DoD level has been largely hands-off for some time. While we have set topical strategic priorities for science and technology efforts, we have not conducted DoD level long range planning or provided strategic R&D investment guidance.” – Frank Kendall in BBP 3.0 white paper
 - Multiple offices have some oversight role, resulting in duplicative reviews and often delays and confusion
- B. The lab structure is large, complex and uncoordinated
 - 67+ labs across 22 states and 39,000+ scientists and engineers conducting ~\$30B in work each year
 - Fiscal Year 2015 President’s Budget Request for DoD S&T \$11.51B*
 - Few labs are proximate to commercial technology hubs
 - Each Service has a different model and lead lab (e.g., Naval Research Lab)
 - Multiple engineering labs, usually weapon/system focused
 - In addition DoD funds University Affiliated Research Centers (UARCs) and FFRDCs
 - Limited overall management or coordination at the Office of the Secretary of Defense (OSD) level

*PBR15 S&T slide in appendix

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Findings

II. DoD faces a number of S&T challenges cont'd

- C. Work force is aging and skills are stove-piped
 - Little movement (experience) across labs and departments
 - Recent programs are attracting some capable young technologists
 - But retention of the best talent continues to be challenging (many are leaving the DoD marketplace due to constrained funding, limits on travel, and frustration with the bureaucracy)
 - Compensation systems are poorly designed to reward successful performance
- D. Industry's Independent Research and Development (IR&D) spending (\$4.5B) is not managed by the Department and is often not coordinated with key technology needs
 - After a 20 year hands-off policy, DoD requires regular summary reports by larger companies
 - Primes spend 80% of the R&D and have wide discretion on how it is used
 - Priority given to known DoD technology needs in areas where they are competitive
 - Companies desire better guidance by DoD on critical future technology requirements (highlighted in past DBB studies). Information is gleaned from face to face contact with the DoD technology community and operational forces as well as industry associations and think tanks
 - The proposed DoD R&D strategy and "Reliance 21" (reference slides in appendix) could provide a better roadmap for industry IR&D spending - if industry is given access

Findings

III. DoD processes fail to attract cutting edge commercial technology

- A. Basic research spending (6-1), which is primarily spent with universities, is loosely coupled with Services' needs
 - Seen as DoD's contribution to university science and education of scientists
 - Recent initiatives are attempting to provide coordination, but close coupling will be challenging
- B. Difficult for DoD to strategically source key technology from private sector
 - DoD has limited visibility beyond Defense Industrial Base and few means to search out relevant, advanced commercial technology
 - Rules limiting conference attendance and outreach to private firms compounds the problem
 - Many private sector companies refuse to deal with DoD (e.g., Google and robotics) due to government regulations and intellectual property (IP) concerns
 - Companies prefer to focus their time and talent on more lucrative and growing commercial markets, including rapidly growing overseas markets
 - Defense Innovation Marketplace, while new, may prove helpful in outreach and there are several success stories. But it is unlikely to have traction with cutting edge technology companies
 - The UK MOD's Centre for Defence Enterprise reaches out to small firms and has a number of successes
 - The intelligence community uses In-Q-Tel to source critical technologies – a process not well suited for DoD more broadly given In-Q-Tel's narrow focus and funding flexibility
- C. Where agility/speed are needed, acquisition process is slow and complex
 - Multi-year acquisition cycles are ill suited for "Moore's Law" world
 - FAR Part 12 provides ways to be more flexible and responsive, but is seldom utilized
 - Recent DBB Innovation Task Group report provides a constructive roadmap to access advanced technology and enhance innovation

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Findings

IV. Recent DoD initiatives show promise to remedy some of these problems

A. Long Range Research and Development Plan (LRRDP)

- Recent USD(AT&L) initiative to create DoD R&D strategy and set of priorities
- Goal: replicate successes of 1970s technology strategy to drive US technological advantage
- Prioritize new or unconventional applications of technology for future capabilities
- Just underway, but has strong senior level support

B. “Reliance 21”

- ASD(R&E) effort to provide a coordinated framework for the DoD S&T enterprise
- Goal: coordinate 6-1 through 6-3 spending across DoD in 17 broad technology categories
- Will require broad coordination and cooperation
- Too soon to measure its impact or sustainability

C. Defense Innovation Marketplace

- USD(AT&L) initiative to connect Industry spending to DoD needs
- Regulatory environment has made informal face-to-face discussions difficult
- Goals: Provide interface between DoD and Industry
 - DoD posts information on key Service technology areas to attract outside input; and
 - Industry submits IR&D project information to DoD to connect investments to DoD needs
- Also used for Service-led “Virtual Technology Interchanges” with Industry
- Unlikely to be effective in sourcing technology input from cutting edge companies which target non-Defense/commercial markets
- Secretary of the Air Force initiative builds on this approach and has aspects similar to the UK MOD CDE program

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Recommendations - Overview

- I. VCJCS, USD(AT&L), and USD(P) should establish a structure and process to develop an S&T strategy, set S&T priorities, identify objectives and metrics, track progress and allocate funds
 - Senior leadership must drive the strategy and priorities
 - Supporting Service strategies would support the strategy
 - Senior OSD/JS officials manage implementation
 - Regular reviews are conducted that result in tough choices
- II. USD(AT&L) should take steps to more aggressively exploit commercial technology which is more advanced in most areas critical to military capabilities
 - This requires a broad effort to remove impediments, e.g., use FAR Part 12
 - Concerns over the impact of IP and ITAR must be addressed
 - Must reach out to the private sector to be aware of technology, e.g., conferences, one-on-one meetings, and locating S&T cells near technology hubs
 - The 2014 DBB Task Group on Innovation provides a detailed roadmap to address this challenge
- III. USD(AT&L) should ensure Defense Industry is provided a more in-depth understanding of DoD's prioritized technology needs
 - Access in detail to S&T priorities would be of great value
 - A role in the requirements process would also be valuable

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Recommendations - Overview

- IV. The R&D establishment, led by ASD(R&E) should focus its internal S&T effort on military unique technologies and not replicate technology available in the private sector
 - Should be based on an assessment of areas where the private sector has limited capabilities
 - Service labs would manage defense unique S&T programs – combined in-house/contractor effort
 - Labs also need the ability to vet (not replicate) commercial technologies

- V. The S&T strategy should include requirements for the capabilities of the DoD workforce and facilities needed to execute the strategy
 - Assess the workforce to determine where added skills are needed
 - Greatly strengthen the rewards system for successful performance
 - Evaluate DoD's S&T infrastructure to drive future investment decisions (consolidate and upgrade)

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The following slides are a more robust discussion of the recommendations

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Recommendations

- I. **VCJCS, USD(AT&L), and USD(P) should establish a structure and process to develop an S&T strategy, set S&T priorities, identify objectives and metrics, track progress and allocate funds**
 - A. We strongly support the recent USD(AT&L) directive to develop an S&T strategy. This is an important initiative which could accomplish much of the above and should be developed and implemented expeditiously
 - B. Strategy should be tightly linked to overall DoD strategy and lay out actionable priorities for key areas (e.g., combat systems, missile defense, cyber, C4ISR).
 - The Senior OSD leaders and the JCS should be deeply involved in setting the strategic priorities
 - Current Defense Strategy should be considered, though it is too broad to set clear priorities
 - C. Service S&T strategies should be developed based on the DoD strategy, focusing on their critical capabilities' needs. If implemented successfully, the Reliance 21 process could play a useful role
 - D. OSD/JS should manage service strategy-driven priorities and resource allocations to ensure they are consistent with DoD strategy and to coordinate the effort where technology needs cross Service lines
 - E. The strategy and objectives should include guidance on what is to be developed internally and specific areas where the private sector would be relied on
 - F. Given tightening budgets lower priority areas should be identified and funds allocated to higher priority needs

Recommendations

- II. USD(AT&L) should lead a series of actions to aggressively exploit commercial technology as it is more advanced in most areas critical to military capabilities**
- A. Potential adversaries have easy access to most commercial technology and are often agile and able to move quickly to exploit it. DoD needs to be able to match this agility
 - B. The Defense Innovation Marketplace reaches out to industry for new technology. This is a useful initiative but is unlikely to have much traction with Silicon Valley and other commercial technology centers. Thus DoD must develop new ways to reach out to find solutions to critical technology requirements
 - Visibility of much advanced technology needs to be improved via active participation in technology conferences and face-to-face meetings with cutting edge companies. S&T executives and lab personnel should be exempted from limitations on conference attendance
 - Pro-active outreach (such as done by In-Q-Tel) may be useful in a few select areas
 - The DoD labs should create small cells of experienced technical personnel near leading private sector centers of excellence (e.g. Silicon Valley)
 - C. USD(AT&L) take action to encourage cutting edge technology companies to do business with DoD. They include:
 - Regular use of FAR Part 12 processes for technology development and procurement will reduce company reluctance to participate in DoD programs
 - Minimizing the impact of IP and International Trade in Arms Regulations (ITAR) issues on their commercial products
 - Onerous requirements such as cost accounting standards and audits are a major deterrent to many companies and should be applied only to major procurements
 - The recommendations from the recent DBB study on Innovation which would remedy most of these problems and should be implemented
 - D. The Better Buying Power initiative should be implemented, especially those elements that would facilitate outreach to advanced technology private companies.

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Recommendations

- III. USD(AT&L) should ensure Defense Industry receives more in-depth information on DoD's prioritized technology needs**
- A.** This will enable their IR&D and self-funded R&D is more productive and responsive to DoD S&T strategy and priorities
 - Industry is anxious to have better access
 - Defense Innovation Marketplace could be helpful
 - B.** Past DBB studies proposed a role for industry in the requirements process which should be reconsidered*. This should provide more technical realism to the requirements and enable industry S&T efforts to be more relevant to DoD needs
 - C.** The UK's quick response program to attract creative solutions and provide modest seed funding should be assessed for adoption by DoD
 - Centre for Defence Enterprise
 - Report a number of successes in getting valuable technologies from small/medium sized companies

*See DBB Report FY12-02 "Linking and Streamlining the Defense Requirements, Acquisition, and Budget Processes"

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Recommendations

- IV. R&D establishment, led by ASD(R&E), should focus its internal development efforts on military-unique technologies and not replicate technology available in the private sector**
- A. When S&T objectives are developed by the Services, those areas should be identified where the DoD labs have unique capabilities or technology not likely to be available in the private sector. These areas should be the focus of the DoD lab structure
 - B. Outreach to private sector technology in other areas critical to DoD future capabilities is inadequate. Over time labs have become more internally focused in part due to tight funding and regulations
 - C. Policies that deter Government scientists from interacting with defense industry and limits on attending conferences should be relaxed to enable badly needed interaction
 - D. Where possible, internal research should be aimed at supporting the common needs of other users to avoid redundant activity and investment, especially important in a time of declining budgets

Recommendations

- V. The S&T strategy should include requirements for the capabilities of DoD workforce and facilities required to execute the strategy**
 - A. The workforce must be capable to undertake the internally developed S&T in military unique areas as well as provide insight into relevant emerging external technologies and oversee/monitor external providers of S&T
 - B. The current workforce should be assessed to determine what skills and capabilities are required to support the S&T strategy and means identified and implemented to retain and develop existing critical talent and to attract talent to fill shortfalls
 - C. Current facilities should be evaluated to ensure that they support the strategy with appropriate capacity and technical capability. This should drive investment decisions as well as facilitate consolidation of the large, decentralized lab structure
 - D. Within the limits of current law, the compensation system for S&T personnel should focus on rewarding concrete achievements related to the specific program goals of the labs and related facilities. Working with USD(P&R), new programs that require legislation should be developed to make the compensation system performance-focused.

Summary

- Commercial S&T best practices differ fundamentally from DoD's
- DoD should learn from these practices:
 - Develop a clear S&T strategy and priorities, driven by the senior civilian and military leadership, and allocate funding accordingly
 - Establish a rigorous management process to track progress, address issues, and make tough choices when programs get into trouble
 - Attack the impediments that frustrate DoD's efforts to exploit commercial technology and deter commercial companies from contributing
 - Revamp the compensation system to reward successes
- Despite budget pressures, DoD still has the resources to invest in the capabilities it needs for the future
- The commercial sector can, and should be a major provider of technology to meet DoD military capabilities



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Questions?

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Appendices

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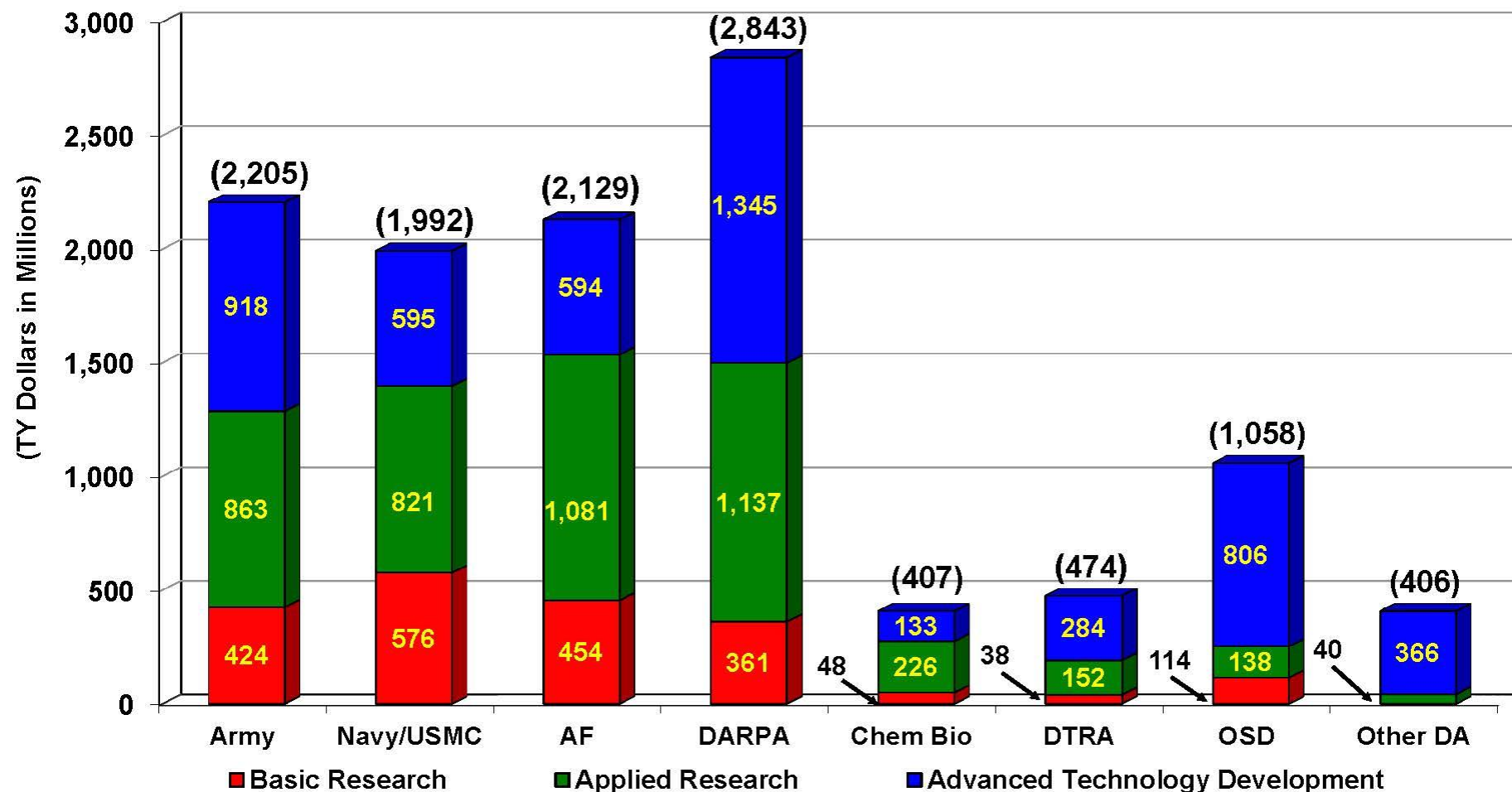


FY 2015 DoD S&T Budget Request

Total FY 2015 S&T request = \$11.51B

Total FY 2014 S&T Request = \$11.98B

Army = 2,205 Navy = 2,033 AF = 2,270 DARPA = 2,793 ChemBio = 449 DTRA = 495 OSD = 1,147 Other DA = 591



DoD Funding Classification System

Classification	Description
<i>Science and Technology Activities</i>	
Basic research (6.1)	Scientific study for greater understanding of phenomena without specific applications in mind. Farsighted, high payoff research.
Applied research (6.2)	Expansion and application of knowledge to understand the means to meet a specific need. Development of useful materials, devices, systems or methods. Official RDT&E estimates of 6.2 do not include Defense Health Research, though this program is included in overall AAAS estimates of the total DOD science & technology budget.
Advanced Technology Development (6.3)	Development and integration of subsystems and components into model prototypes for field experiments and/or tests in a simulated environment. Proof-of-concept testing.
<i>Weapons Development Activities</i>	
Advanced Component Development and Prototypes (6.4)	Evaluation of integrated technologies or prototypes in realistic operating environments. Technology transitions from laboratory to operational use.
System Development and Demonstration (6.5)	Development of mature systems in preparation for actual production. Prototype performance established at or near planned operational system levels, including live fire testing.
RDT&E Management Support (6.6)	Funds to sustain or modernize installations or operations for the performance of general RDT&E, including test ranges, military construction, and maintenance for laboratories and test vehicles.
Operational System Development (6.7)	Efforts to upgrade systems that have been fielded or have received approval for full production in the near term.

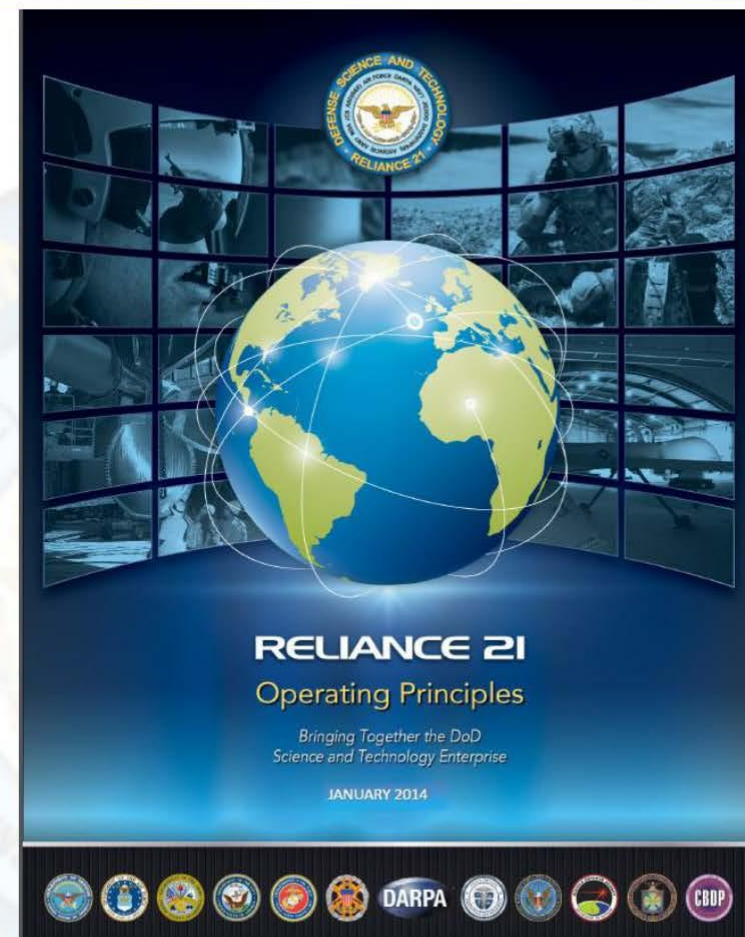
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What is Reliance 21?

- Reliance 21 is the overarching framework of the DoD's S&T joint planning and coordination process
 - Reliance 21 has roots that go back several decades, and has been continually renewed and refreshed
- An ecosystem of cross-cutting collaborative teams that enable information sharing, alignment of effort, coordination of priorities and support for the scientists and engineers across the Department
- Strengthens coordination and efficiency to ensure the utmost value from investments in science and technology



Found at

www.DefenseInnovationMarketplace.mil and
www.acq.osd.mil/chieftechologist/index.html

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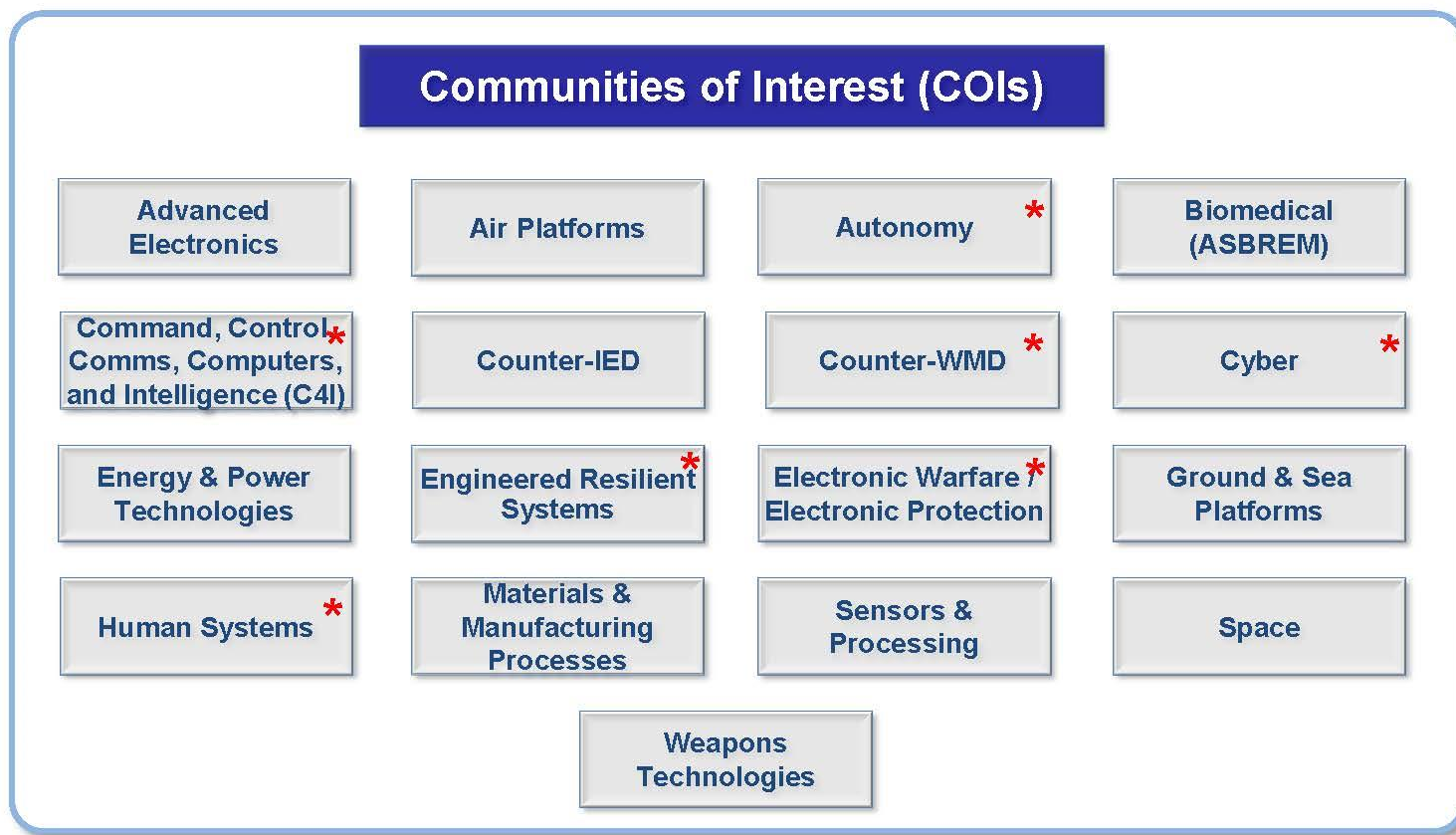
What are COIs?

- 1) COIs (Communities of Interest) are groups of scientists and engineers who are subject matter experts in specific cross-cutting technology areas where there is substantial investment across multiple Components**
- 2) COIs were established in 2009 as a mechanism to encourage multi-agency coordination and collaboration in cross-cutting technology areas with broad multiple-Component investment.**
- 3) COIs provide a forum for coordinating S&T strategies across the DoD, sharing new ideas, technical directions and technical opportunities, jointly planning programs, measuring technical progress, and reporting on the general state of health for specific technology areas**
- 4) COIs are led by Steering Groups of senior technical leaders who take on a leadership role for their area**
 - Build and implement strategic roadmaps**
 - Empowered to identify gaps and issues, and make recommendations to the S&T ExCom**
 - Identify lead / co-lead / follow relationships across the Components**
 - Identify opportunities to leverage external investment and expertise**



Communities of Interest

There are 17 COIs up and running, with many new Steering Group members, and significant participation from the Services



* Denotes COIs that cover the DoD cross-cutting S&T Priorities (Data-to Decisions is found in C4I)

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Building COI Roadmaps

Strategic outlook, 10 to 15 years



- **What are technology opportunities / goals / objectives?**
- **What is military impact of meeting those technical targets?**
 - Technical opportunities that will enable new missions or capability, or achieve some game changing level of performance
- **What technical plans are in place, and where are the gaps?**
 - When does it need to happen to make a difference?
 - What are recommended approaches to close gaps / deliver opportunities?
- **What are the opportunities to leverage external investment / expertise?**
 - Cross-Govt, Industry, Academia, and International

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Defense Innovation Marketplace

CONNECTING INDUSTRY & DoD

- Established in 2010 as part of Better Buying Power 1.0 initiative. Goal is to enable communication between DoD and Industry on IR&D projects and investments
- The Defense Innovation Marketplace is a centralized resource for market research:
 - For Industry to learn about Department of Defense (DoD) S&T/R&D investment priorities, capability needs and technology interchanges
 - For Government to access search tools to assess and then leverage industry IR&D projects for current and future programs

- From <http://www.defenseinnovationmarketplace.mil/index.html>

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In-Q-Tel Background

- Launched in 1999 as an independent, not-for-profit organization, In-Q-Tel (IQT) was created to bridge the gap between the technology needs of the U.S. Intelligence Community (IC) and emerging commercial innovation. We identify and invest in venture-backed startups developing technologies that will provide “ready-soon innovation” (within 36 months) vital to the IC mission. These technology startups are traditionally outside the reach of the IC; in fact, more than 70 percent of the companies that IQT invests in have never before done business with the government.
- As a strategic investor, the IQT model is unique. IQT Investments accelerate product development and add mission-critical capabilities with the sole purpose of delivering these cutting-edge technologies to IC end users quickly and efficiently. By focusing on commercial technologies and investing side-by-side with venture firms, IQT leverages outside funding to help develop sustainable technologies using off-the-shelf products instead of custom-built solutions. On average, for each dollar that IQT invests in a company, the venture capital community invests more than nine dollars.

- From IQT website

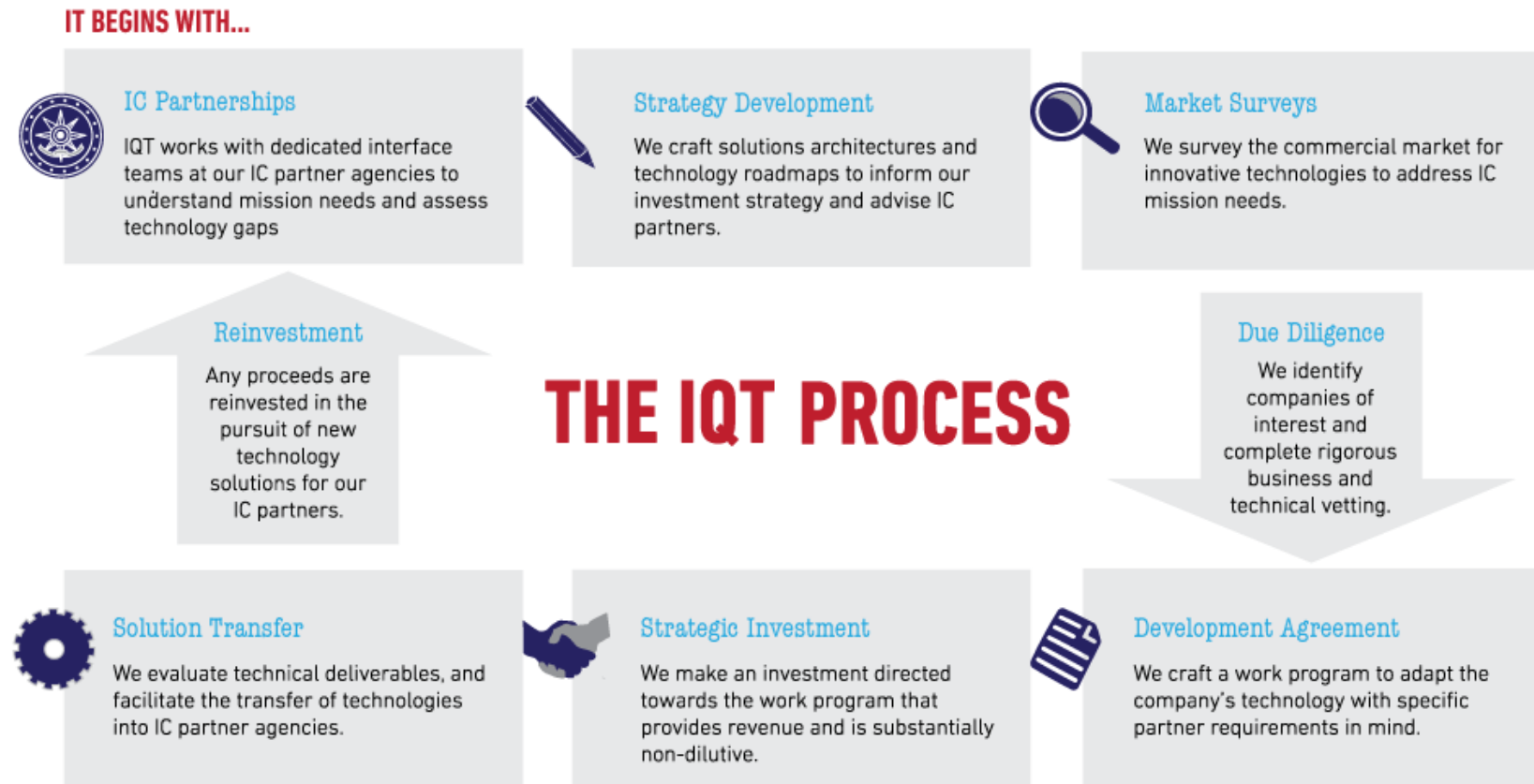
<https://www.iqt.org/about-iqt/>

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In-Q-Tel Process

- The advantages of the IQT model are significant: lower initial and long-term costs, faster development, and ongoing product enhancements to meet IC mission requirements.



- From IQT website

<https://www.iqt.org/about/iqt/>

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DEFENSE BUSINESS BOARD



Centre for Defence Enterprise

- The Centre was established by the United Kingdom Ministry of Defence (MOD) in 2008 to find technology solutions especially from small and medium sized businesses
 - About £25M have been disbursed in over 500 contracts
 - Most concepts are early technology needs (TRL 2-4)
 - Roughly half has gone to small and medium sized businesses
 - The current annual budget is £3M
 - Other agencies use the Centre on occasion

 - Companies respond on-line to one of the Enduring Challenge Competitions or periodic Themed Competitions
 - A brief proposal is submitted using a prescribed format and the Centre responds in about 45 days
 - If found interesting, contracts ranging from £40K to £80K are given for the company to do proof of concept research for the proposed solution
 - This process lasts 3 to 9 months
 - At that point, if promising, follow on contracts are awarded, usually in 2 to 3 months
- <https://www.gov.uk/government/organisations/centre-for-defence-enterprise>

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Centre for Defence Enterprise cont'd

- Enduring Challenge Competition Areas* are:
 - Protection
 - Power
 - Lethality
 - Mobility
 - Lower Ownership cost
 - Situational Awareness
 - Communications
 - Data
 - Human Performance
- A recent Themed Competition was for highly robust ground platforms with contract awards up to £500K
- CDE also holds webinars to outline technology needs in specific areas. A recent example is “Detection of Airborne Chemical Hazards”
- The MOD has reported a number of successful developments flowing from the Centre process. Example:
 - An imagery based system to locate hostile forces from the air, combining a new vision based tracking system with GPS
 - E-textiles which allow electronic power and data to pass through material
- Recent MOD White Paper states the process will be expanded

*each challenge area has subsidiary areas.

- <https://www.gov.uk/government/organisations/centre-for-defence-enterprise>

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What is Crowdsourcing?

- Crowdsourcing is the process of getting work or funding, usually online, from a crowd of people. The word is a combination of the words 'crowd' and 'outsourcing'. The idea is to take work and outsource it to a crowd of workers
- Famous Example: Wikipedia. Instead of Wikipedia creating an encyclopedia on their own, hiring writers and editors, they gave a crowd the ability to create the information on their own. The result? The most comprehensive encyclopedia this world has ever seen
- Crowdsourcing & Quality: The principle of crowdsourcing is that more heads are better than one. By canvassing a large crowd of people for ideas, skills, or participation, the quality of content and idea generation will be superior

- From Daily Crowdsourcing

<http://dailycrowdsourcing.com/training/crowdsourcing/what-is-crowdsourcing>

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Case Study 1 – Large Petroleum Services Company

I. Approach

- R&D driven by company's top-down corporate strategy coupled with an "outside-in" process requiring business units to identify and prioritize customer needs, based on the strategy. Well conceived needs, not "blue sky." Believe collaboration between R&D staff and line staff is the best way to innovate
- Disruptive technologies only get a small part of the R&D investment. Can only take so much risk. Need to adequately fund the core business. Need metrics for both core and disruptive R&D efforts

II. Corporate research must be mission oriented

- No science for sake of science – let universities do that (though may partner sometimes)
- If critical to mission, they do some basic research (e.g., on materials)
- Research effort is organized by mission. This keeps R&D relevant to the corporate strategy. Most R&D done by mission teams, only a little done centrally
- Scientists and engineers in mission-oriented R&D units report to the mission line leader, but are considered part of the corporate R&D structure
- Teams are cross-disciplinary and often include ultimate users of S&T
- Rotate field engineers into corporate R&D organization. Improves connectivity and makes central R&D more reliable
- Manufacturing and development must be integrated. Computer-aided design systems help make this happen
- If the prize is big enough, consider establishing parallel work efforts but with rigorous stage-gate management

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Case Study 1 – Large Petroleum Services Company (cont'd)

II. Corporate research must be mission oriented cont'd

- Sharing across mission focused R&D teams is challenging. Have an annual meeting to cross-fertilize, which helps but does not solve the problem
- Central S&T budget funds projects relevant to multiple business units
- Project management based on stage gate reviews that assess the spending risks and timelines at every decision point/milestone

III. Innovation Workshops are important part of process

- Set forth the problems and challenges for the top 5 issues. Very open, no dumb ideas
- Sometime decide to outsource the development if company lacks the needed core competence

Case Study 2 – Large Pharmaceutical Company

I. R&D is central to corporate management

- New products are the lifeblood of the company. Strategy is driven by an assessment of the disease areas in order to set priorities. Look at unmet medical needs, 10 years in the future.
- Where is the science evolving? Which transformational products will be possible? What innovations are possible and will people pay for them? Use external experts to challenge in-house thinking
- Clarity of focus is critical
- High failure rates (90%) at very high cost. Working to improve success rates. Use right talent with clear missions and right time frame. Hold them accountable but reward intelligent failure
- Use data-driven milestones. Rigorous reviews at each stage gate. Often kill or double down.
- Cannot do all R&D internally. Assess own core competence, and if additional capability needed, can it be acquired? Often work with Venture Capitalists and co-invest in cutting edge companies to get access to best people and products

II. Management of the pipeline

- Done by senior leadership team. Key elements of the process:
 - Have two forums, early and late experiments
 - Do the product teams have a culture of “truth seeking”?
 - Do the product teams bring forward the best solution?
 - Use rigorous external reviewers and devil’s advocates
 - Reward (bonuses) progress and recognize the right process/experiments and move to next stage. Are considering rewards for intelligent failure if they failed for the right reason. Want people to be willing to take more risk
 - Collaborate with academia and small, genetic medical companies. Partnership is a big part of their strategy
 - Increasingly focused on making choices in their product lines, divest low priority units
 - Talent is key; attract needed talent, create environment for teams to work productively

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Case Study 3 – Large Energy Company

I. Strategy

- R&D must be aligned with strategy of company. Not how much you spend, but how you spend it that creates value
- R&D must meet business needs. Target specific technologies and time frames. Do not do “blue sky” research
- Governance by Technology Advisory Board made up of senior corporate leadership (except Chairman). Includes business unit leaders
- Goal: get good technology into the businesses and deployed

II. Process: The Technology Advisory Board assesses:

- How company compares to competitors. The outside world is the technology landscape
- Where do we stand in various categories of technology? Should we build or buy? When is technology required? How can long timelines be cut in half?
- Look for ways to try technology early – learn from failure
- Assess technology readiness using NASA scale TRL 1-8
- Keep competitive technology world in view: universities, competitors, where dollars are spent

Case Study 3 – Large Energy Company (cont'd)

III. Management

- Efficiency and alignment only works if governance and networking also work. The company is decentralized but cannot let each unit do their own thing. Each business unit has a technology plan
- Business units must be involved in the technology plan – they must buy in
- Sharing current information on S&T across business units prevents reinvention of the wheel
- Crown jewel technologies get the resources and are done in-house. Reach out to others, leverage them for lower priority technology. Work with other companies, sometimes competitors, for pre-commercial technology
- Have 16 to 18 strategic university partners (MIT, Texas, Texas A&M, CO School of Mines, etc.). Another 20 to 30 are used in particular areas of technology. Have an executive sponsor for each university. Also oversees hiring against a strategic workforce plan
- Work with DOE labs. Work on fracking, CO² sequestration technologies. Set up “Skunk Works”-type collaboration with Los Alamos
- Work with VCs to find new technology startups; acquire 20% participation and get Board seat
- Identify quick wins and communicate them in context of big picture – visibility of the data helps people make better decisions